SPS-H305 Power Supply

(This guide was written by Jos Verstraten on 02-04-2021)

Scope of delivery of the SPS-H305
The SPS-H305 power supply comes in a sturdy cardboard box and is well protected inside with styrofoam blocks. In addition to the power supply, two sturdy flexible test leads with a length of 100 cm and a banana plug on one side and a crocodile clip on the other are included. An excellent 130 cm mains cable with earthed plug and IEC C14 connector is also included. A small 16-page English manual completes the delivery.



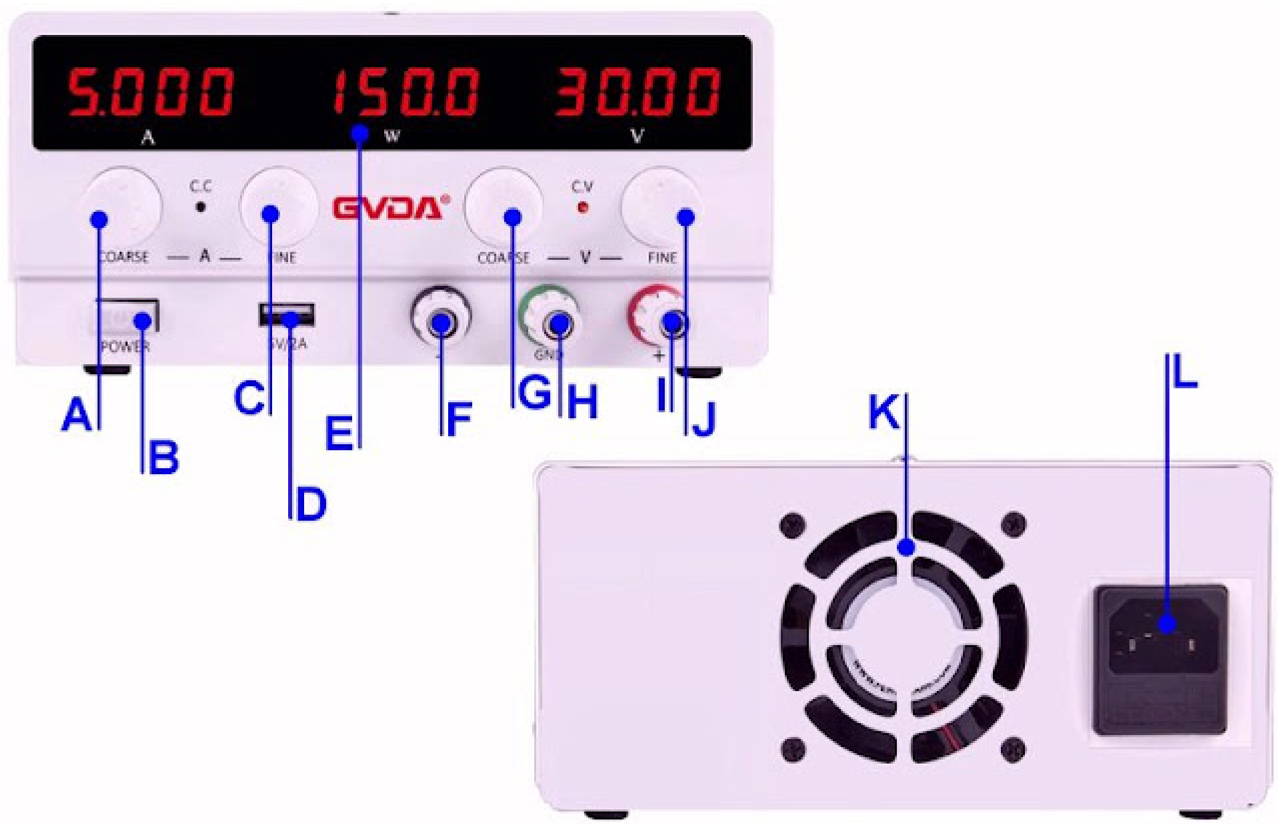
The scope of delivery of the SPS-H305 laboratory power supply.

Appearance of the SPS-H305
The power supply comes in a nice flat metal casing that is 25.2 cm wide and only 8.4 cm high. Only the front panel is of plastic. The depth is 17.0 cm and the weight is 1.4 kg. The device, on its four rubber feet, fits nicely on our rack among all kinds of other equipment.
Dominant on the front are the three 4-digit LED displays with a digit height of 10 mm and a bright red appearance. Indeed, this power supply not only has displays for the supplied voltage and current, but also calculates the supplied power which is shown on a third display.
It is worth noting that this power supply also provides a 5 V USB power supply via the well-known USB-A connector, which can be loaded up to 2 A.

The function of the controls

- **A**
  The coarse setting of the maximum output current.
- **B**
  The on/off switch.
- **C**
  Fine adjustment of the maximum output current.
- **D**
  The 5 V USB power connector that can supply 2 A.

- **E**
The display, showing from left to right the current, the power and the output voltage. Current and voltage have a resolution of 10 mV and 1 mA. The resolution of the wattmeter depends on the measured value: 1 mW to 100 mW.
- **F**
The negative output connector, a 4 mm banana socket.
- **G**
The coarse output voltage setting.
- **H**
The GND connector, a 4 mm banana socket.
- **I**
The positive output connector, a 4 mm banana socket.
- **J**
The fine adjustment of the output voltage.
- **K**
The outlet of the built-in fan. This fan is intelligent, which means that it only starts running when the temperature on the internal heatsink becomes too high. This does not happen often, which is fortunate, because this fan makes a lot of noise.
- **L**
The C14 panel mount IEC connector with built-in standard 3.15 A glass fuse for connecting the earthed mains cable.



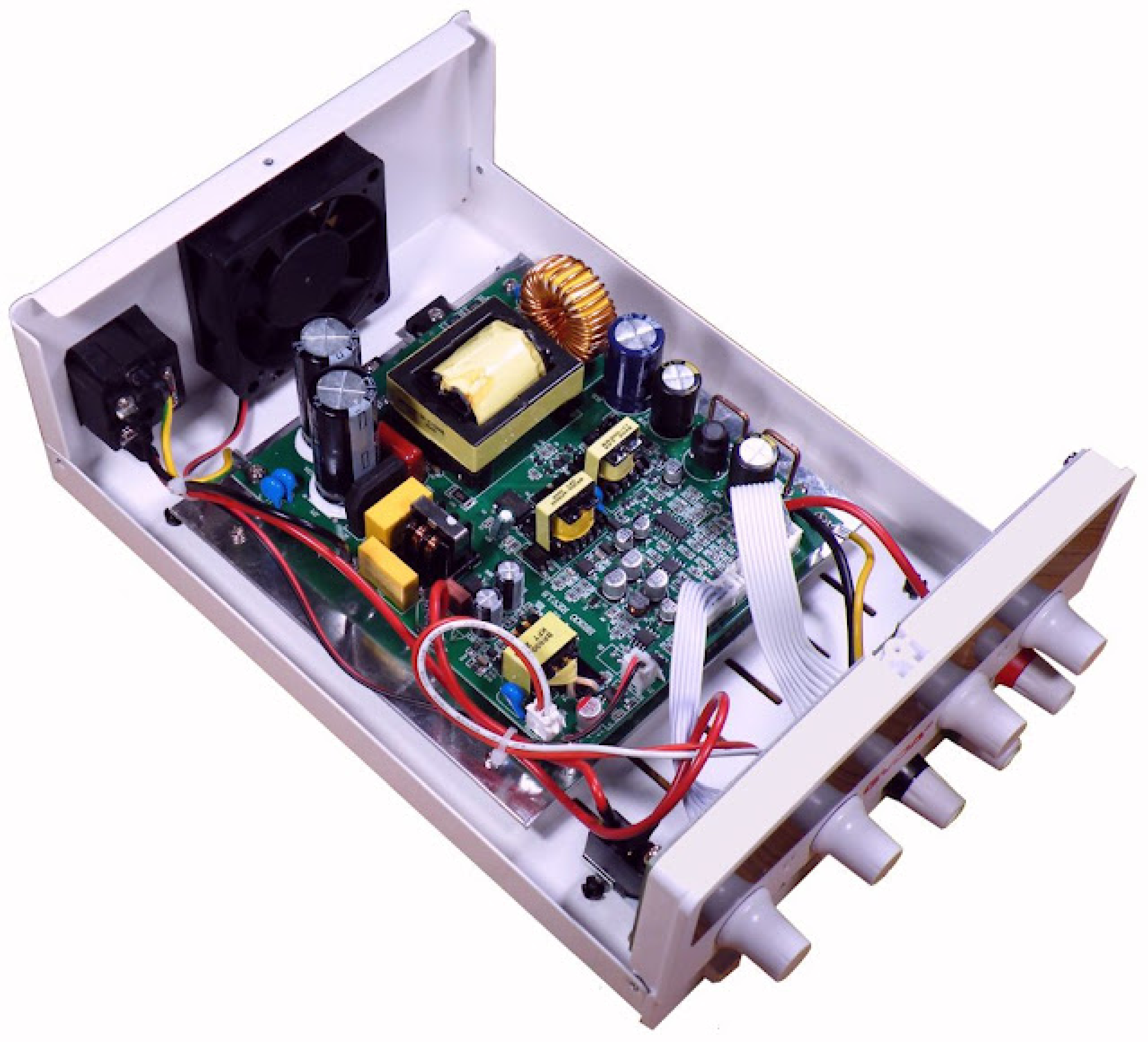
The front and rear panels of the SPS-H305.

The technical specifications of the SPS/H305
According to the manufacturer, the instrument meets the following specifications:
- **Line voltage:** 220 V_{ac} ± 10 %
- **Output voltage:** 0 ~ 30.00 V_{dc}
- **Voltage setting resolution:** 10 mV
- **Input voltage stability:** 0.05 % ± 1mV
- **Output voltage stability:** 0.1 % ± 1 mV
- **Long term stability:** 0.1 % ± 3 mV
- **Ripple and noise on voltage:** less than 10 mV_{rms}
- **Output current:** 0 ~ 5 A_{dc}
- **Resolution current setting:** 1 mA

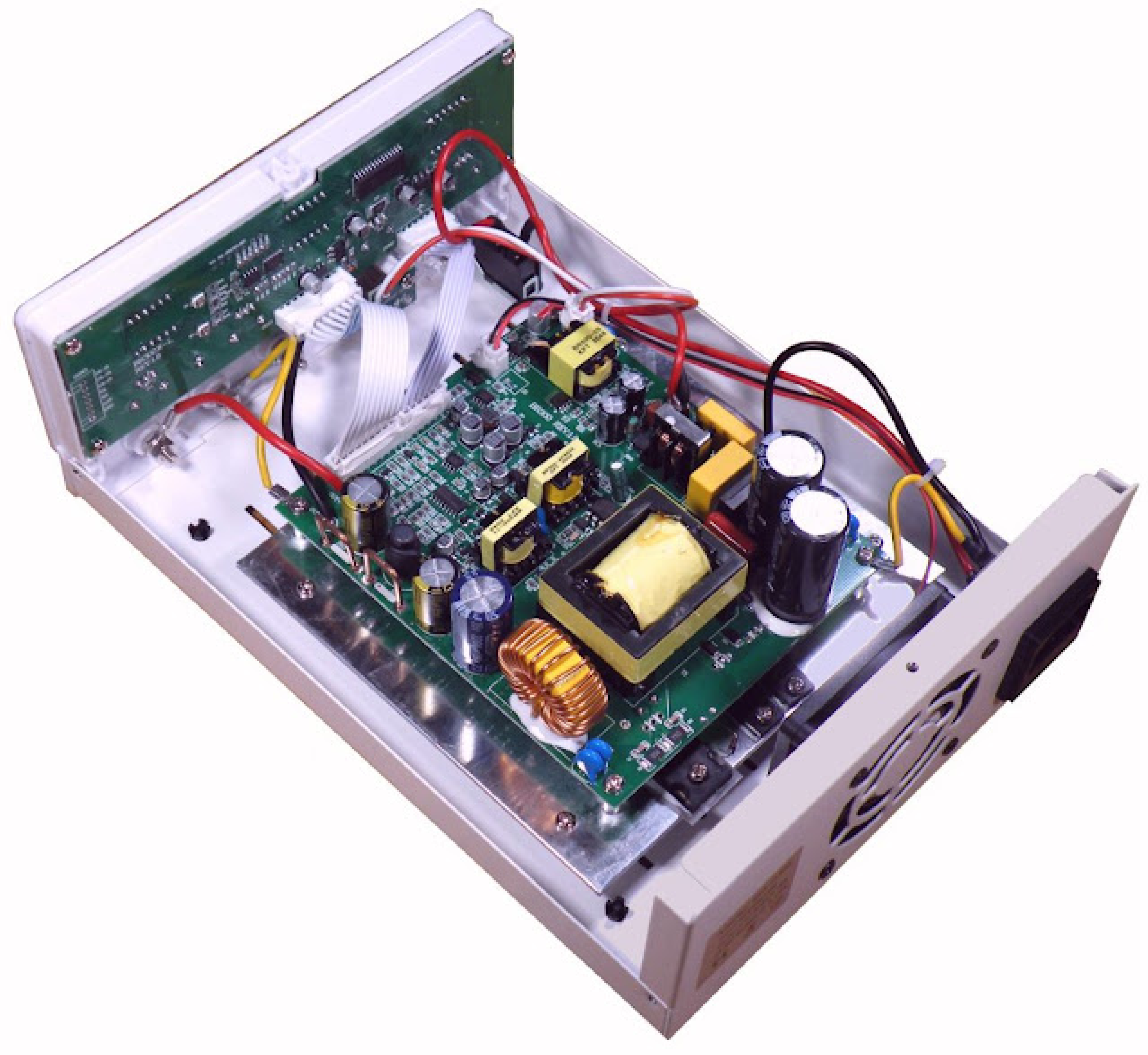
- **Output current stability:** 0.1 % ± 10 mA
- **Output power:** 150 W max.
- **Power measurement resolution:** 1 mW ~ 0.1 W
- **Earth resistance:** less than 20 mΩ
- **Accuracy of digital meters:** 1.0 % ± 2 digits
- Over current protection (OCP)
- Over temperature protection (OTP)
- Over power protection (OPP)

The casing opened

The enclosure consists of a U-shaped base containing the electronics and a U-shaped lid that are screwed together. After removing six screws, you can examine the electronics of this power supply. As the two photos below show, you won't be disappointed. The whole construction looks neatly finished. All soldered wires carrying the mains voltage are finished with shrink tubing. Under the entire main PCB is a large aluminium heatsink, on which all the semiconductors to be cooled are mounted insulated. This heatsink is cooled by aeration slots in the bottom and in the two side walls of the housing and, of course, by the fan.



A view into the power supply from front to back.



A view into the power supply from back to front.

What is striking is the way in which the manufacturer has dealt with the grounding of the device. The grounding pin of the C14 panel mount IEC connector on the back of the enclosure is connected with a very short wire to one of the metal spacers with which the PCB is attached to the enclosure. The GND socket on the front panel is similarly connected to another metal spacer. The ground resistance is specified as less than 20 mΩ and with this construction, that could very well be the case. But of course, we are going to measure that!

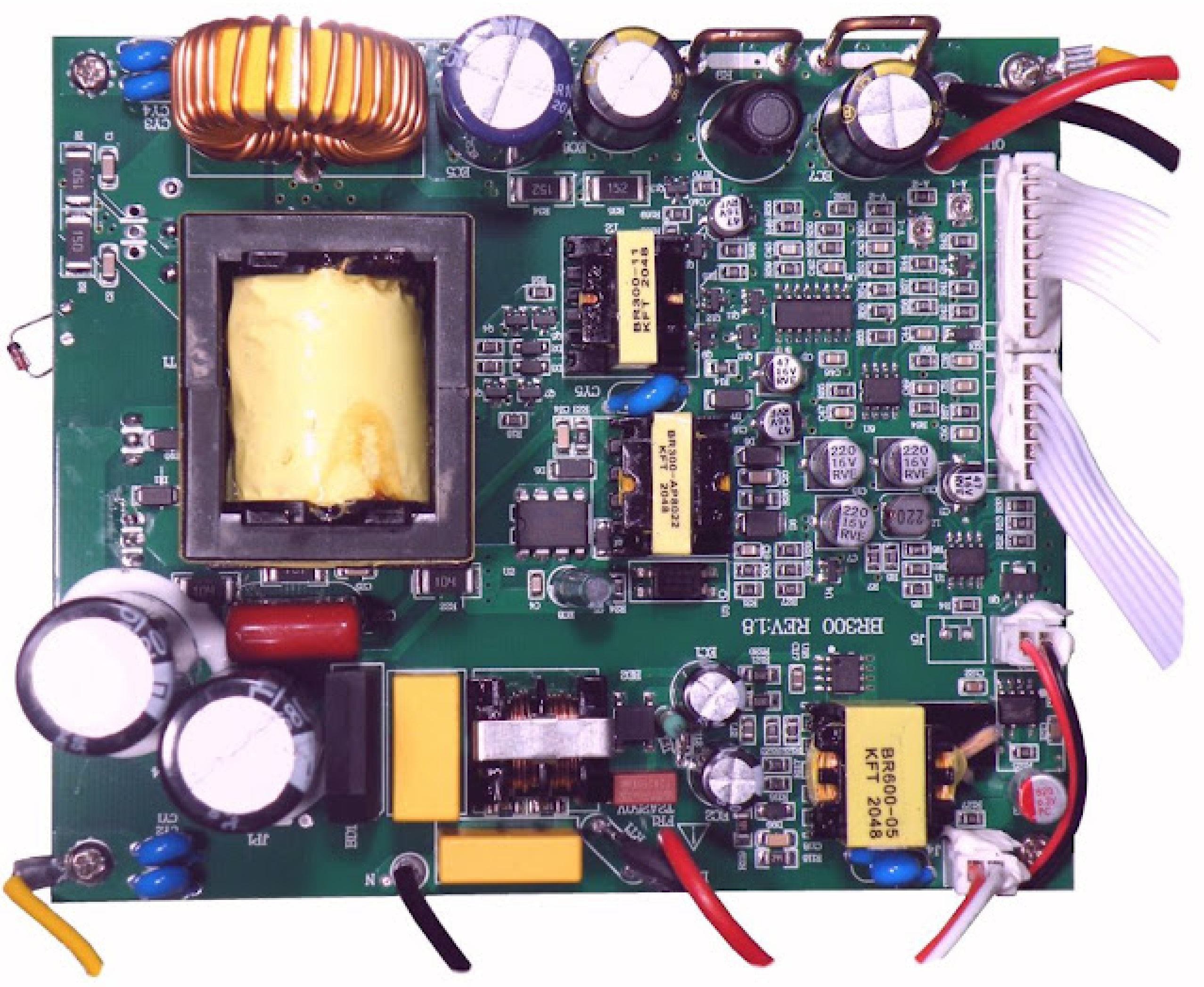
The main PCB in detail

The photo below shows the main circuit board in detail. At the bottom, the mains voltage is fed to the board via a red and a black wire. There is a primary mains filter present and you can clearly see the two large high-voltage electrolytic capacitors at the bottom left, which smooth the rectified mains voltage.

What is immediately clear is that the 5 V USB power supply is completely separated from the other parts of the electronics. The electronics for this power supply can be seen on the bottom right of the PCB. After a bridge rectifier for the mains voltage, two electrolytics of 10 µF and 400 V form the primary DC voltage. An LP3669 is used to regulate this rectified mains voltage. An LP15R045S stabilises the secondary voltage at 5.0 Vdc.

The mains voltage is also rectified via a second large bridge rectifier and smoothed by two 680 µF electrolytics with a working voltage of only 200 V. These will therefore (hopefully) switched in series. An AP8022 regulates the primary DC voltage for the main power supply. In this system we find a TL494, a PWM regulator that stabilises the output voltage. Also on the main PCB are two LM358 dual op-amps and a CY022 opto-coupler, which probably controls the galvanically isolated

feedback for stabilising the voltage of the main power supply.
On the left side of the main PCB you can see a diode sticking out. This diode is in thermal contact with the heatsink and is responsible for switching on the fan at the right moment.
On the top right you can see two '*wire bridges*'. These are obviously the sensor resistors that converts the supplied current into a small voltage to drive the current control and the digital current meter.



Detail of the large main circuit board.

On the display board, behind the front panel, is a TM1640. This is a seven-segment driver for sixteen displays that undoubtedly drives the twelve LED displays. Also on this board we find an OP07, a fairly expensive op-amp from Analog Devices with a very low offset. The intelligence of the device is in an N76E003AT20, an eight bit 16 MHz flash type microcontroller.

Conclusion
The electronics of this SPS-H305 power supply make an excellent impression. The heavy parts on the PCB are mechanically stabilised with sealant. There are only four wires soldered directly to the PCB. All other connections are made via professional-looking PCB connectors. Unfortunately, for some reason, they are glued so that it is almost impossible to remove the PCB from the instrument.